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PRELIMINARY GEOLOGIC MAP OF THE VENETA 7.5′ QUADRANGLE, LANE COUNTY, OREGON

By

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Preliminary Geologic Map of the Veneta Quadrangle, Lane County Oregon

Introduction

The Veneta quadrangle is at the southern end of the Willamette Valley, west of Eugene, Oregon (Figure 1). It is entirely within Lane County and includes the city of Veneta and the smaller town of Elmira.

Access to the quadrangle is provided by Oregon Highway 126, which runs east-west through the center of the quadrangle, passing through Veneta and Elmira; and Territorial Highway, which connects Highway 126 to points north through Elmira. Numerous all-weather roads provide good access to the rest of the quadrangle.

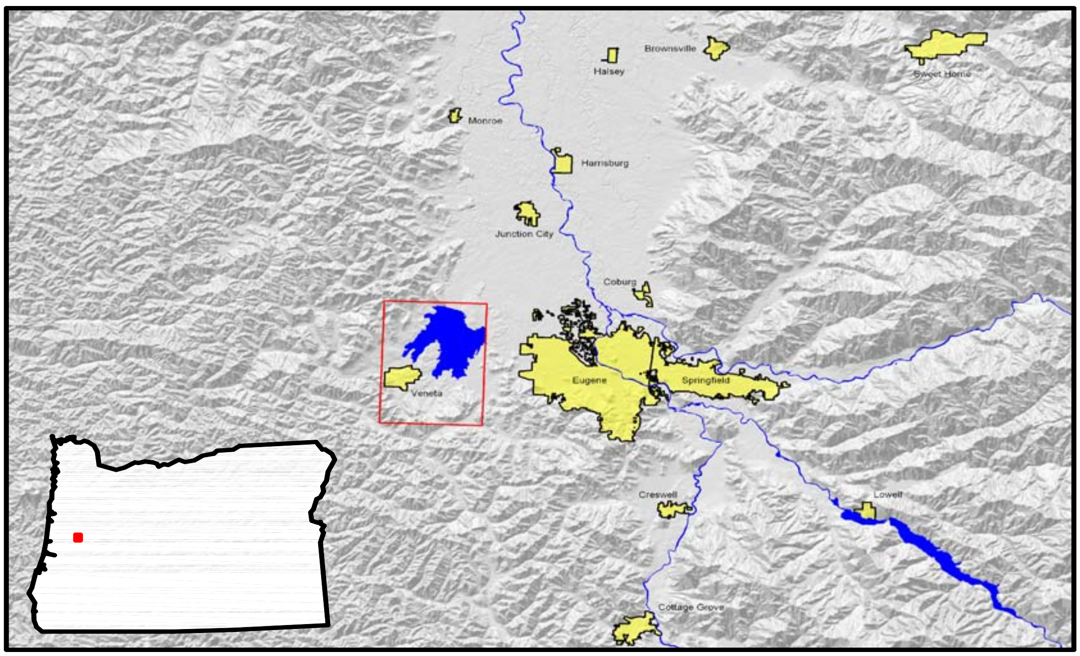

Figure 1. Location map of Veneta quadrangle.

Fern Ridge Lake is the dominant physiographic feature in the quadrangle. It fills the lowland area behind a Corps of Engineers dam built across Long Tom River and Coyote Creek for flood control in 1941. The lake covers approximately 26% of the quadrangle at high water. Rocky Butte, in the southwest corner of the quadrangle, is the highest point in the study area at 368m (1206 ft). The lowest point is 100 m (329 ft) along Long Tom River just downstream from Fern Ridge Dam.

Rural areas within the quadrangle are dominated by home sites and small farms in the lowlands; the hilly areas are predominantly timberland. The land under and closely surrounding Fern Ridge Lake is owned by the U.S. Army Corps of Engineers and administered by the Oregon Department of Fish and Wildlife. Other public land includes several Lane County parks adjacent to Fern Ridge Lake.

The population of Lane county increased nearly 18% from 1990 to 2004; the city of Veneta grew nearly 33% in just the four years between 2000 and 2004 (Population Research Center, Portland State University). Development to provide for such rapid population growth requires an adequate supply of clean water and natural resources. The purpose of this mapping was to add detail to existing small-scale geologic maps of the quadrangle and provide for more accurate ground water modeling, improved natural resource inventories and a basis for geologic hazards assessment.

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Methods

Field work for this study was conducted in fall and winter of 2004-5. Stations were located with a Trimble GeoXT GPS receiver. Post-processing reduced position error to less than 3m. In the rare case that a station was obscured by tree cover its position was estimated based on nearby stations and topography.

An extensive network of roads covers the quadrangle providing good access and exposure. Although most of the study area is privately owned, landowners were helpful and accommodating, and no part of the quadrangle went unexamined (Data Map on Plate 1).

Rock descriptions for sedimentary rocks are based hand lens or binocular microscope examination. Four igneous rocks selected for chemical analysis were examined petrographically. Major oxide and trace element analyses of those rocks were performed by Dr. Stan Mertzman at Franklin and Marshall College. Sample locations are shown on the map; chemical analyses are provided in the appendices as a Microsoft Excel spreadsheet. Analytical methods used by Dr. Mertzman are described in appendices, as well.

Contacts were refined by air photo, National Resources Conservation Service soils maps, and well log interpretation. No new paleontological studies were conducted. Fossil localities shown on the map include stations located in this study, as well as localities listed by Vokes and others (1951). Only macrofossil and plant localities are shown. Data for fossil localities is given in the appendices.

Previous mapping in the quadrangle includes studies that focused on the petroleum potential of the sedimentary rocks (Gandera, 1977; Vokes and others; 1951) or on the surficial deposits (O'Connor and others, 2001). Regional studies that bear on the geology of the quadrangle include Ryu and others (1992), Molenaar, (1985), Baker, (1988), Baldwin (1975), Bird (1967), and Snavely and others, (1964).

Explanation of map units

The Veneta quadrangle is at the eastern edge of the Oregon Coast Range. Upland areas in the quadrangle are underlain primarily by Eocene marine sedimentary rocks of the Tyee Formation, Lorane Shale, and Spencer Formation. Volcaniclastic mudflow deposits of the Fisher Formation and the Tuff of Gimpl Hill Road, derived from the western Cascades, form a thin veneer over the marine sediments locally in the southeast corner of the quadrangle. Mafic and intermediate dikes and sills intrude both the marine and terrestrial sedimentary rocks. Low areas around Fern Ridge Lake are blanketed with Pleistocene gravel and finer grained Holocene sediments.

Volcanic rock names follow usage of LeBas and others (1986), using chemical analyses normalized to 100% without volatiles and all iron as Fe^{2+}. Mineralogic descriptions are based on petrographic analysis. Epoch designations are based on Palmer and Geissman (1999).

Rf Artificial Fill (Recent)

Road fill, building pads, and Fern Ridge Dam; many smaller dams containing farm ponds scattered across the quadrangle are not mapped separately. Mapped primarily from topography and stereo air photo interpretation.

Qa Fine Grained Alluvium (Holocene)

Sandy mud and minor gravel deposited along the Long Tom River and low gradient streams within the smaller valleys south and west of Fern Ridge Lake. Derived from hillsides adjacent to the deposits. Includes recent mud deposits at the bottom of Fern Ridge Lake and Missoula Flood deposits inferred from the presence of exotic clasts of schist, gneiss, greenstone, and granite exposed at the lake during periods of low water. Thickness unknown, but probably less than 10 meters.

Qal Terrace gravel (Pleistocene)

Deeply weathered fluvial sediments, predominantly pebble conglomerate, deposited by the early Willamette River. Exposed at Fern Ridge Lake during periods of low water, in a roadcut in east Veneta, and along Inman Creek, which is incised 4-5 m into the terrace surface. Distinguished from younger fluvial sediments by the intense weathering-softened volcanic clasts are surrounded by matrix now nearly completely altered to clay. Distinguished from weathered Fisher Formation by its scarcity of angular clasts. Mapped in this report primarily after O'Connor and others (2001). U.S. Army Corps of Engineers (1940) borehole logs report thickness of up to 57 m (188.3 ft) east of Fern Ridge Dam, the unit feathers out against underlying marine sedimentary rocks surrounding the lake basin. O'Connor and others (2001) report a discordant $^{40}Ar/^{39}Ar$ age of about 700-800 ka for obsidian from a site along Inman Creek, and estimate the unit to be between about 800ka and 420 ka.

Ttg Tuff of Gimpl Hill Rd. (mid-Eocene)

Thin deposit of pyroxene-bearing plagioclase-lithic tuff that crops out just above the base of the Fisher Formation in the southeast corner of the quadrangle. Consists of polymict lava lithics up to 1cm, abundant fresh euhedral plagioclase up to 2mm, and pyroxene that occurs as 1-2mm irregular grains intergrown with plagioclase and as euhedral green needles up to 2mm long, The recrystallised ash matrix shows shapes of relict glass shards. A plagioclase separate from a sample collected in the Eugene West quadrangle provided an $^{40}Ar/^{39}Ar$ age of 41.81 ± 0.50 Ma (Madin and Murray, 2004).

Tf Fisher Formation (late mid-Eocene)
Volcaniclastic conglomerate and breccia, pebble conglomerate, and rare sandstone. Unconformably overlies Spencer Formation in the southeast corner of the quadrangle and surrounds Fisher Butte along the eastern quadrangle boundary. Typically consists of well-rounded to angular volcanic clasts up to 10 cm in a mud matrix that is commonly altered to clay. Only the base of the Fisher Formation crops out in the Veneta quadrangle. The age of the Fisher Formation deposits within the study area is constrained by the~42 Ma age of the Tuff of Gimpl Hill Road, enclosed within the Fisher just above its base, and the absence of the ~41 Ma Tuff of Fox Hollow, which is interbedded with Fisher Formation just east, in the Eugene West quadrangle.

Ts Spencer Formation (mid-Eocene)
Massive to thickly bedded, mica-bearing sparsely fossiliferous, arkosic sandstone, locally with thin mudstone interbeds. Thin coal seams crop out at Richardson Butte (Gandera, 1977) and near the top of the formation in the southeast corner of quadrangle (Vokes and others, 1951; Madin and Murray, 2004). Good exposures crop out in the swash zone of Fern Ridge Lake at low water levels. Fisher Formation is about 160 m thick in southeast corner of quad, where it can be measured between Lorane Shale and Fisher Formation; more than 120 m is exposed in Richardson Butte. Fossil assemblages suggest a mid- or late-Eocene age for the Spencer Formation (Gandera, 1977; Ryu and others, 1992); however the ~42 Ma age of overlying Tuff of Gimpl Hill Road restricts the age to be no younger than mid-Eocene.

Tl Lorane Shale (mid-Eocene)
Gray, tan, and brown laminated micaceous mudstone that underlies low hills in the southeast quarter of the quadrangle. The best exposures are along Petzold Road and just south of Central School. Thickness in the Veneta quadrangle is approximately 210 m. The contact between the Lorane Shale and underlying Tyee Formation is not exposed in the quadrangle. The upper contact with Spencer Formation is gradational locally (Vokes and others, 1951; Gandera, 1977) but despite the occurrence of interbedded shale and sandstone near the contact in the Veneta quadrangle, measurements of bedding in the two formations along Petzold Road indicate that there is an angular unconformity between the two units (see Structural Geology section for more details). For this report the contact with the Spencer Formation is mapped at the base of the first thick sandstone layer. The Lorane Shale is correlated with the mid-Eocene Elkton Formation, based on its stratigraphic position over the Tyee Formation and similar fossil assemblages (Bird, 1967; Molenaar, 1985; Ryu and others,1992).

Tt Tyee Formation (early- to mid-Eocene)
Rhythmically bedded turbidite sandstone and mudstone that crops out extensively in the west half of the quadrangle. Fresh rock, only observed in drill cuttings and in a baked(?) zone beneath the sill at Rocky Butte, is gray green. In outcrop the sandstone is tan, yellow, or orange, the mudstone light-tan or white. Locally the layering is crosscut by amorphous red claystone developed along fractures and bedding planes. Sandstone layers are typically 0.5-1.5 m thick, are massive to within 10-15 cm of the top of the

layer, then grade quickly to mudstone. The mudstone is typically 10-15 cm thick, but may be missing in some beds. The contact between the mudstone and overlying sandstone layer is sharp, though locally flame structures and slump structures are observed in the mudstone and mudstone rip-ups are found a few centimeters into the overlying sandstone. Flute casts and lode casts, commonly observed elsewhere in the formation (Snavely and others, 1964; Gandera, 1977) were not observed in the Veneta quadrangle. Apparently deep weathering of the sandstone precludes preservation of overhanging ledges that would display those structures. No fossils were observed other than carbonized plant fragments that are abundant locally. The unit was not examined for microfossils. Small outcroppings may not expose mudstone, but light colored mudstone chips are nearly always present as float at the base of the outcrop. The sandstone is composed of angular quartz and feldspar, lithics, and abundant biotite and muscovite. Gandera (1977) reports that much of the light mica is in fact bleached biotite. Sandstone layers in the Tyee Formation are very similar to sandstone in the Spencer Formation. In the field the two formations are distinguished by the greater abundance of mica, especially biotite, the ubiquitous occurrence of mudstone in or below the outcrop, and its lack of marine fossils in the Tyee. The thickness of the Tyee regionally may be 3,000 m (10,000 ft, Snavely and others, 1964); the unit is at least 775 m (2,540 ft) thick in the southwest part of the Veneta quadrangle. The base of the Tyee Formation is not exposed within the Veneta quadrangle and the contact with overlying Lorane Shale is buried, but Gandera (1977) reports exposures of the contact just south of the quadrangle along Doane Road and Briggs Hill Road (Crow Quadrangle). The age of the Tyee is late-early Eocene to early-middle Eocene, based on coccolith assemblages (Bukry and Snavely, 1988), and foramanifera (Snavely and others, 1964).

Ti Intrusive Rocks (Eocene to Oligocene)

Medium grained, greenish-black basaltic to andesitic dikes and sills. Sills at Fisher Butte, Richardson Butte, and Rocky Butte form prominent outcroppings; smaller intrusives are mapped based on float and water well logs. The basalt at Fisher Butte has well-developed columnar jointing, sills at Richardson Butte and Rocky Butte are massive. Classification of the intrusive rocks is shown in Figures 2. Geochemical analyses are listed in Table 1. Richardson Butte consists of randomly oriented, subhedral plagioclase, typically less than 1 mm, with albite twinning and patchy, normal zoning. Clinopyroxene is anhedral or rarely subhedral, twinned, up to 0.75 mm. Orthopyroxene occurs as subhedral to anhedral seriate grains up to 2.5 mm, and is commonly altered to green-brown clay and chlorite. Magnetite is anhedral or rarely euhedral, skeletal or inclusion filled, and occurs as chunky grains up to 0.75 mm. Clear quartz and brown titanite are rare accessories. The dike mapped in the northwest part of the quadrangle (sample VN-48) has olivine rather than orthopyroxene, and plagioclase occurs as rare phenocrysts up to 4 mm. Rocky Butte, a silica-rich basaltic andesite, consists of intergrown, randomly oriented plagioclase and pyroxene up to about 1 mm, with rare rounded quartz up to 1.5 mm. Plagioclase is frosty white, pyroxene variably altered to chlorite.

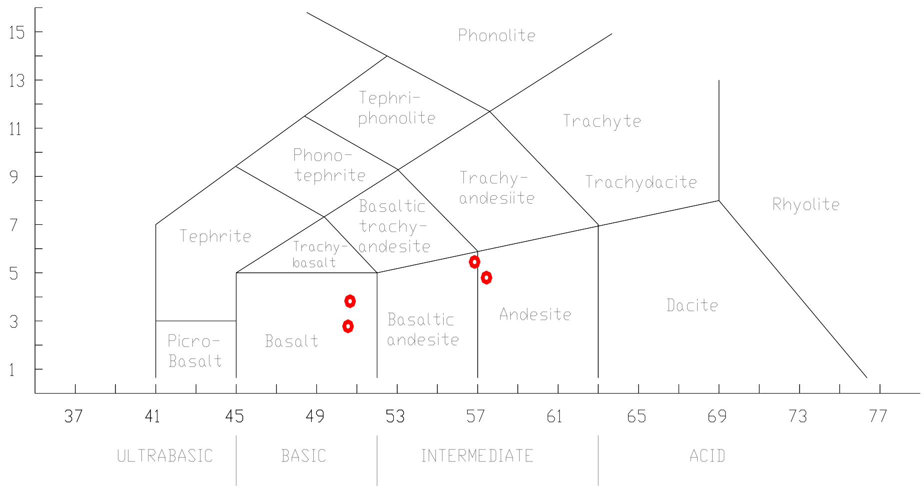

Figure 2. Total Alkalies-Silica classification diagram with analyses from Veneta quadrangle.

Structural Geology

Bedrock in the Veneta quadrangle is only moderately deformed. Bedding is slightly folded, and on average dips gently to the northeast. Stereonet plots of poles to bedding planes are shown in Figure 3. In the stereonet plots, poles normal to the bedding plane are projected to the lower hemisphere, thus bedding dipping to the northeast would project a dot in the southwest quadrant of the stereonet. Poles to gently-dipping beds plot near the center of the stereonet, steeply dipping beds near the outer edge. Because bedding measurements are sparse in many parts of the quadrangle, especially from the Tyee Formation, measurements from a scan of Vokes and others (1951) map, and some measurements taken from outside the quadrangle (but within approximately 2 km of the quadrangle boundary) are included to improve the statistics.

In the plot for the Tyee Formation, the additional data does increase the scatter somewhat, but are centered around the data collected from within the quadrangle. The majority of the poles plot in the western half of the net, with a slight tendency to plot toward the southwest quadrant, indicating an average regional dip of bedding in the Tyee to be just north of due east.

Poles to bedding measurements collected from the Lorane Shale plot along a best-fit great circle suggesting open folding around a SSW-trending axis that plunges slightly to the southwest. The relatively tight pattern, contrasted with the scatter in the plot for the Tyee Formation is due, probably, to the small area of outcrop for the shale. Clearly, the Lorane Shale could not be folded without folding the underlying Tyee Formation, as well.

The plot for the Spencer Formation , although broadly consistent with the east-northeast dip of bedding observed elsewhere in the quadrangle, is very scattered. The best explanation for the scatter is the hummocky cross-stratification of bedding, observed in outcrop near the west end of Fern Ridge Dam, and is probably present elsewhere but

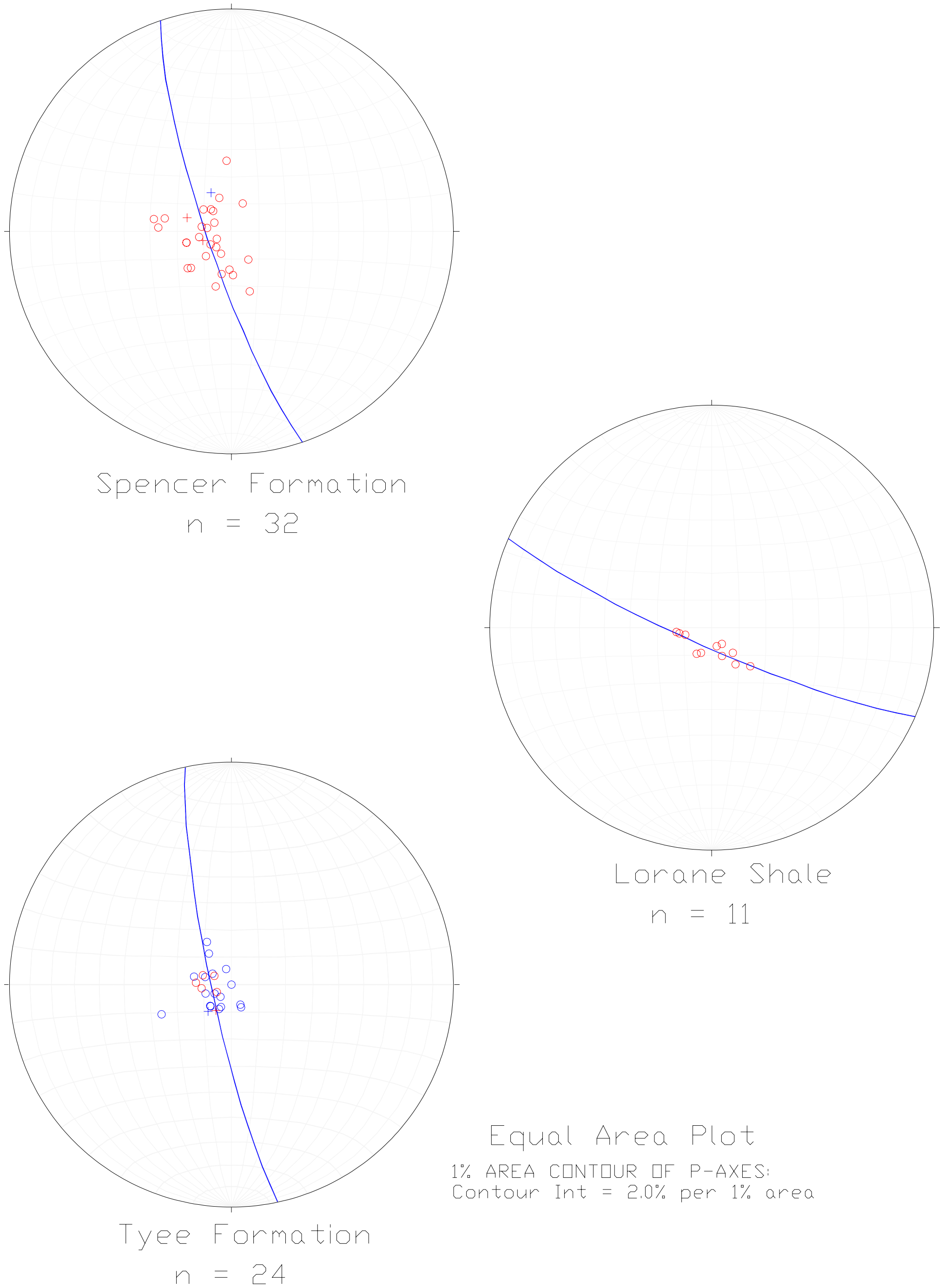

Figure 3. Stereonet plot of poles to bedding planes. Measurements taken for this study are shown by circles, measurement taken from Vokes and others (1951) are shown by crosses. Measurements collected inside the quadrangle boundary are shown in red, outside the quadrangle (but within an ~ 2 km of the quadrangle edge) are shown in blue. A great circle for the cylindrical best-fit of the data in each formation is shown in blue.

not recognized due to the small size of most exposures. This bedding structure is formed by wave action and is characteristic of shallow marine deposition (Dott and Bourgeois, 1982).

The absence of distinctive layers in much of the quadrangle makes mapping faults difficult. Only two faults were mapped in the study area,. Both trend NW-SE, consistent with several faults mapped in the adjacent Eugene East quadrangle (Madin and Murray, 2004). The age of these faults is poorly constrained, as they cut only Eocene bedrock.

The first fault, south of Cantrel Road in the southeast part of the quadrangle, is interpreted to be normal dip-slip; the apparent offset of Fisher Formation to the northwest due to the shallow ENE dip of the bedding in that part of the study area. Alternatively, because the Fisher Formation was clearly deposited over a very uneven paleosurface, the outliers may, in fact, simply be erosional remnants of the more resistant conglomerate.

The second fault, south of Petzold Road, is inferred based on bedding orientations measured in the Lorane Shale that are discordant with the general SE dip assumed for Tyee Formation southeast of the contact. However, this fault is also speculative. The scarcity of bedding measurements in Tyee Formation nearby may preclude recognition of broad folding that could also be responsible for the bedding orientations measured in the shale.

Gandera (1977) speculates that the absence of Lorane Shale north of Central Road might be explained by unrecognized faulting. The inferred down to the NE offset of the faults discussed could explain that outcrop pattern. However, the shale appears to be thinning to the north. The estimated thickness of the Lorane Shale at Briggs Hill, just south of the Veneta quadrangle, is about 490 m (1600 ft; Bird, 1967) and the thickness in the Veneta quadrangle is approximately 210 m. The fact that the shale is absent between Tyee Formation and Spencer Formation in the north part of the quadrangle is consistant with thinning to the north, as well.

Geologic History

Most of the bedrock units that crop out in the Veneta quadrangle were deposited within about a 10 million year period during late- to mid-Eocene. The oldest rocks are rhythmically bedded sandstone and mudstone of the Tyee Formation deposited by turbidity currents into a forearc basin beginning in the late early-Eocene (Snavely and others, 1964; Molenaar, 1985, Ryu and others, 2002; Wells and others, 2000).

Overlying the Tyee Formation is the well-laminated mudstone of the Lorane Shale. The Lorane Shale is a remnant of a once continuous shale layer, now represented by the Elkton Formation in the southern part of the Tyee Basin (Bird, 1967; Molenaar, 1985). Contact relations between the Lorane Shale and underlying Tyee Formation differ regionally. In the southern Tyee Basin the Elkton Formation interfingers with upper Tyee (Wells and others, 2000). In the southern Willamette Valley Vokes and others, (1951) mapped the shale as the basal member of the younger Spencer Formation, the Tyee and Lorane shale being separated by an uncomformity. In the mid-Willamette Valley, however, Vokes and others, (1954) considered the Lorane Shale more closely related to the Tyee Formation.

The contact between the formations is not exposed within the Veneta quadrangle. Measurements of bedding in the two units are discordant near the contact, but this may be due to faulting at the contact. Overall, stereonet plots of bedding measurements overlap, suggesting the two are probably conformable (see Structure Geology section). Foraminifer ages (Bird, 1967) and coccolith ages (Bukry and Snavely, 1988) indicate that no significant time elapsed between deposition of the two units.

After a short period of non-deposition, the shallow marine sandstone of the Spencer Formation was laid down. Coal deposits and fluvial interbeds near the top of the Spencer Formation (Vokes and others, 1951; Gandera, 1977) indicate that near the end of the middle Eocence sea level had dropped to the point that Spencer Formation was very near shore. Overlying late middle-Eocene Fisher Formation and interbedded Tuff of Gimpl Hill Road are terrestrial volcaniclastic deposits.

Fossil evidence indicates Spencer Formation is late Eocene in age (Ryu and others, 1992) but within the Veneta quadrangle the age of overlying terrestrial deposits restricts the age of the Spencer Formation to mid-Eocene. The ~42 Ma age of the Tuff of Gimpl Hill Road, (Madin and Murray, 2004), deposited just above the base of the Fisher Formation, and the absence of the ~41.0 Ma Tuff of Fox Hollow, (Retallack and others, 2004), indicate that deposition of the sedimentary rocks was complete before ~41 Ma.

The youngest bedrock units in the quadrangle are mafic and intermediate dikes and sills that intrude the marine sedimentary rocks. The age of these intrusives is unknown, but they are probably late-Eocene to Oligocene age.

North-south paleocurrent indicators and the presence of granitic and metamorphic grains in the Tyee Formation led early workers to conclude that the source for the sandstone was the Klamath Mountains (Snavely and others, 1964; Gandera, 1977). After those papers were published, however, paleomagnetic studies have shown that the Oregon Coast Range has undergone at least a 50° clockwise rotation since the middle Eocene (Simpson and Cox, 1977; Heller and Ryberg, 1983). In addition, isotopic studies by Heller and others (1985) and detrital zircon ages obtained by Wooden and Wells (1999) suggest the sediment source for the Tyee Formation is more likely the Idaho batholith.

Surficial deposits in the quadrangle consist of Pleistocene terrace gravels deposited by the early Willamette River, and younger fine-grained sediments that were derived from local sources and deposited into the small valleys adjacent to the basin now holding Fern Ridge Lake. Some of the smaller modern streams are incised into the terrace gravels, indicating a lowering of base level since Pleistocene time. During the Pleistocene the Missoula Floods brought exotic clasts into the southern Willamette Valley. Although no mappable deposits were found in the Veneta Quadrangle, granitic and metamorphic pebbles and cobbles can be found scattered around the bottom of Fern Ridge Lake at low water.

Acknowledgements

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fossil localities, and other observations that aided the geologic understanding of the Venetal quadrangle.

Stereonet plots were done with Rick Allmendinger's program, StereoWin, v. 1.2.

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Appendices

(Data Files on CD)
All coordinates in UTM Zone 10 NAD 27

Geochemistry
XRF_Methods.txt: Discussion of analytical methods
Veneta Geochemistry.xls: Geochemical data in Excel spreadsheet format, with coordinates.

Field Locations
Veneta Station Data.xls: Field data, brief notes in Excel spreadsheet format with coordinates
Veneta Stations read me.txt: Explanation of data collection and abbreviations used in field notes.

Well Locations
Well_data.xls: Well locations with coordinates, OWRD Log ID number in Excel Spreadsheet Format. Location error estimated, xy in meters, z in feet. Located by TL (taxlot), GPS (GPS reading in field)

Veneta Quadrangel Photographs
Veneta Photo Notes.xls: Outcrop and panoramic photos in .jpg format, keyed to Station number in Veneta Station Data.xls

Petrography
Scanned thin sections and polished thin section billets as .jpg files keyed to Station number in Veneta Station Data.xls

Paleontology
Veneta Fossil Data.xls: Excel spreadsheet of fossil locations with coordinates, keyed to Station number and Vokes and others (1951) fossil locality ID.

Veneta GIS
Veneta_Polygons.tab, .shp: Geology polygons labeled with unit ID, in Mapinfo Tab and Arcinfo Shape file formats.
Veneta_Faults.tab, .shp Fault polylines: labeled with fault data in Mapinfo Tab and Arcinfo Shape file formats.